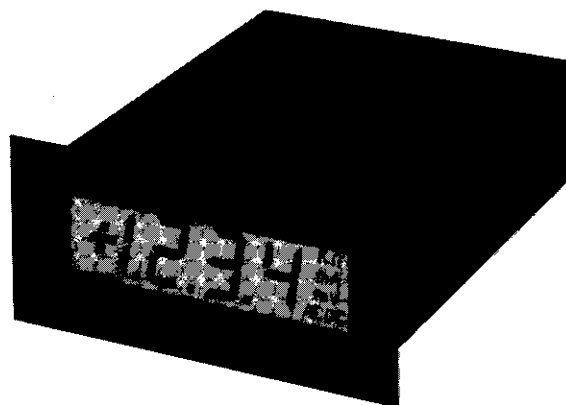


## FEATURES

- Ultra-low power, 9 mA from 9V battery
- .5" high Liquid Crystal Display
- 3½ digits, 5V or 9-15V powered, ratiometric reference for drift correction
- Programmable Descriptor Labels: A, mA, V, mV,  $\Omega$ , K $\Omega$ , AC, DC
- Balanced differential inputs, 5 pA bias current, autozeroing with 80 dB CMR noise rejection
- Low profile model accepts optional 4-20 mA inputs
- Internal user-options:
  - Offset pot for 4-20 mA and other applications
  - Accepts shunts for  $\pm 20 \mu\text{A}$  to  $\pm 2\text{A}$  FS ranges
  - Accepts attenuators for  $\pm 2\text{V}$  to  $\pm 1\text{KV}$  FS ranges
  - Digital ohmmeter, 2K $\Omega$  to 10M $\Omega$ , FSR



## GENERAL DESCRIPTION

The DM-3100U1 is a 3½ Digit Liquid Crystal Display (LCD) Digital Panel Meter that uses extremely low power (+5V @ 6 mA or +9V @ 3 mA) and has a power voltage range of +4V to +15 Vdc. The large 0.5" display can be seen from many feet away under normal room lighting conditions. This DPM is contained in a very small low profile case which makes for higher packing density on test panel faces. Besides measuring dc voltages, components can be placed internally to make resistance and current readings possible, and to display descriptor labels, mA, mV, K $\Omega$ , AC or DC to indicate which function is being used. Also, the decimal point can be internally selected by jumpering appropriate pins. The user may add internal attenuators to measure higher dc voltages up to  $\pm 1$  kV.

The versatility of this meter is further enhanced by its autozeroing capabilities. If the customer desires, an offset pot can be internally installed so that a desired reading can be obtained with a zero input to the meter.

This DPM accepts a dc or slowly varying input voltage between  $\pm 1.999\text{V}$  and displays that input on front panel numerical indicators. It employs a conventional dual-slope A/D converter plus 7 segment display decoder-drivers all in one LSI microcircuit. Since this microcircuit requires approximately 9V to power the A/D sec-

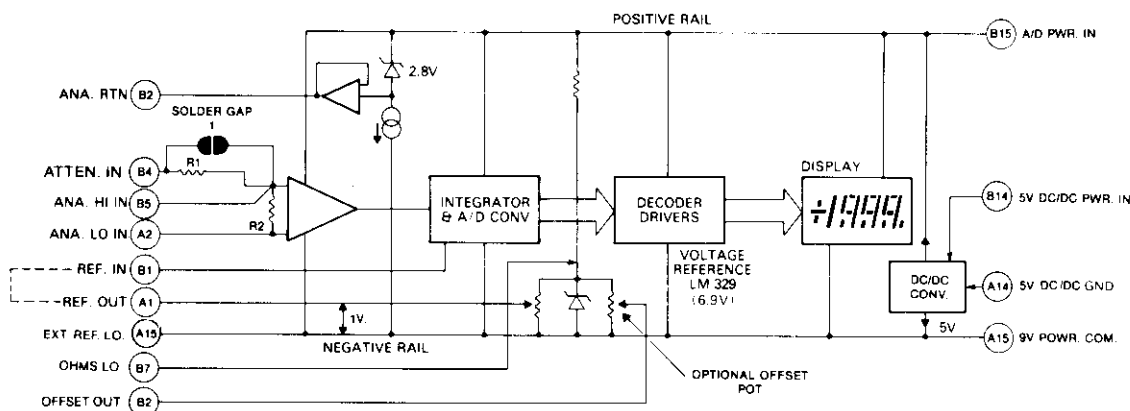
tion, an internal DC/DC converter generates  $-5\text{V}$  from +5V power input. Together these two voltage sources form a bipolar power supply to power the A/D converter. The DM-3100U1 may also be powered directly from a single 9V battery @ 3 mA without using the DC/DC converter.

Another feature of the DM-3100U1 is that it employs a balanced differential input. When used with a bridge or transducer input, it offers high noise immunity and can accurately measure very small signals in the presence of much larger common mode noise. Another characteristic of this balanced differential input is that it will not load down sensitive input circuits due to its high input impedance of 1000 megohms, and low 5 pA bias current.

A very noteworthy feature of this meter is that it can be operated ratiometrically. This means that it has internal circuits that can automatically compensate for reference drifts in the supplies of balanced bridge or transducer sensors and still give accurate readings.

The DM-3100U1 finds use in analytical instruments, industrial process controllers, portable diagnostic instruments, automatic test equipment, medical and patient monitoring instruments, airborne, marine and ground vehicles, and data acquisition/data logging systems.

## SIMPLIFIED BLOCK DIAGRAM



## SPECIFICATIONS, (Typical @ +25° C unless noted)

## ANALOG INPUT

## Configuration

True, balanced differential bipolar

## Full Scale Input Range

-1.999 Vdc to +1.999 Vdc. Input pad area will

accept user-installed range change

## Input Bias Current

5 pA typical, 50 pA maximum

## Displayed Accuracy @+25° C

Adjustable to  $\pm 0.1\%$  of reading,  $\pm 1$  count

## Resolution

1 mV

## Temperature Drift of Zero

Autozeroed  $\pm 1$  count over 0 to +50° C

## Temperature Drift of Gain

$\pm 50$  ppm of Reading/° C typ.

$\pm 100$  ppm of Reading/° C max.

## Input Impedance

100 Megohms, minimum

## Input Overvoltage

$\pm 250$  Volts dc 175 VRMS continuous max.

$\pm 300$  Volts intermittent max.

## Common Mode Rejection

80 dB, dc to 60 Hz, 1 Kiloohm unbalance

## Common Mode Voltage Range

Within +Vs - .5V and -Vs +1V where +Vs is

the positive rail (Pin B15) and -Vs is the

negative rail (Pin A15) -Vs is approximately

equal to -5V below PWR. COM.

## Reference

Internal, referred to the negative rail (-Vs).

External, user-supplied reference optional for

ratimetric operation

## External Ref. Range

$\pm 100$  mV to +2V, referred to -Vs

## Ramp-up Time

(Integration Period)

83.3 mS

## DISPLAY

## Number of Digits

3 decimal digits and most significant "1" digit

(3½ digits)

## Decimal Points

Selectable decimal points are included for scale multipliers.

## Display Type

Field effect liquid crystal displays (LCD)

requiring room light for viewing. Black digits against a light background.

## Display Height

0.5 inches (12.7 mm)

## Overscale

Inputs exceeding the full scale range blank

the display, leaving a "1" MSD and sign

## Autopolarity

A minus sign is automatically displayed for negative inputs, and may also be blanked

## Sampling Rate

Factory set at 3 conversions per second. May

be rewired up to 20 conversions/second

## Descriptors

k $\Omega$ , mA, mV, ACDC

This field of function labels is positioned to the right of the decimal digits. Individual unit descriptors may be selected for display.

## I/O CONNECTIONS

## Analog HI Input (Pin B5)

## Analog LO Input (Pin A2)

Differential input voltages are connected between these inputs. A bias current path to POWER COMMON (if 5V-powered) or ANALOG RETURN from both these inputs must be externally provided. External circuits must constrain these inputs to be within the common mode voltage range.

## Analog Return (Pin B2)

This pin may be used as a low-noise bias current return for some floating inputs. If not possible, inputs may be referenced to POWER COMMON (if 5V-powered). Analog Return is approximately 2.8V below +Vs and can sink 30 mA to -Vs. Do not connect Analog Return to +5V or +9V power. Analog Return may be connected to 5V Power Common (not 9V Pwr Com/-Vs!) for single-ended input

## Reference In/Out (Pins B1/A1)

Normally, REF. IN and REF. OUT should be jumpered together. An external floating source referred to EXT. REF. LO (Pin A15) may be substituted for ratimetric operation.

## Decimal Points (Pins B8,9,10)

Connect selected pin to DECIMAL POINT COMMON (Pin B11) Connect unused decimal points or Descriptors to Backplane Out (Pin A11)

## Offset Out (Pin B3)

0 to +6.9V referred to -Vs (pin A15) requires installation of optional offset pot supplied by user

## Display Test (Pin B6)

Connect this input to pin B15 to test all display segments

## Horizontal Polarity In (Pin A12)

## Horizontal Polarity Out (Pin B12)

Normally these inputs are jumpered together to continuously display the horizontal portion of the polarity sign. Omit the jumper for applications not requiring sign display. See Backplane Out.

## Vertical Polarity In (Pin A13)

## Vertical Polarity Out (Pin B13)

Jumper these inputs when HORIZ. POL. is jumpered for automatic sign display with bipolar inputs. For reverse sensing applications, VERT. POL. OUT may be jumpered to HORIZ. POL. IN (no other connections). This will display a minus sign with positive inputs and no sign (implied positive) with negative inputs. See Backplane Out.

## Ohms Lo (Pin B7)

This connection is used in the ohmmeter configuration, otherwise do not use.

## Backplane Out (Pin A11)

Connect all unused Polarity, Decimal Points and Descriptors to Backplane Out. For VOM or DVM applications, a 470 k $\Omega$  resistor may be used for each Decimal Point or Descriptor to A11. A rotary switch pole to B11 will then select the desired Descriptor and/or Decimal Point.

## Descriptors

Electrical units are displayed by connecting to the Descriptor Common. Descriptors displayed are as follows:

"mA" (Pin A3) - "m" portion only

"k $\Omega$ " (Pin A4) - "k" portion only

"k $\Omega$ " (Pin A5) - "k" portion only

"mA" (Pin A6) - "A" portion only

"mV" (Pin A7) - "V" portion only

"DC" (Pin A8)

"AC" (Pin A9)

"mV" (Pin A10) - "m" portion only

IMPORTANT NOTE: The descriptors display labels only. They do not select functions. This meter does not directly measure ohms, mA, AC, etc. without first adding user-installed internal or external components.

## POWER CONNECTIONS

## A/D Power IN (Pin B15)

Connect this pin to +5 Vdc regulated to power the A/D converter and displays. Connect to +9V for 9V configuration.

## 5V DC/DC Power Common (Pin A14)

Use only for the 5V power configuration. This provides power return for the DC/DC converter.

## 5V DC/DC Power IN (Pin B14).

Connect to the +5V supply if a single +5V supply is to be used. This will power the DC/DC converter to generate -5V. Don't use this pin in the 9V power configuration.

## POWER REQUIREMENTS

5V between B14/B15 and A14 (A15 no connection); 12 mA typ., 15mA max. OR 9 to 15 Vdc between B15 and A15 (B14, A14 no connection); 9V, 9 mA; 15V, 20 mA. max.

## Calibration

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

## PHYSICAL-ENVIRONMENTAL

## Low Profile Case Outline Dimensions

2.53"W  $\times$  3.25"D  $\times$  0.94"H (64.3  $\times$  82.5  $\times$  23.8 mm)

## Cutout Dimensions

2.56"W  $\times$  0.97"H min. (65.1  $\times$  24.6 mm)

## Mounting Method

Through a front panel cutout secured by 2 side case "L" brackets and screws (supplied). Panel thickness up to 0.62" (15.9 mm)

## Weight

Approximately 5 ounces (142g)

## Connector

Double-sided edgeboard PC type, solder tab, gold-plated fingers, 15-pin, 0.1"

## Mounting Position

Any

## Operating Temperature Range

0 to +50° C

## Storage Temperature Range \*

0° C to +55° C

## Altitude

0 to 15,000 feet (4900m)

## Relative Humidity

20% to 80% non-condensing

\*WARNING: Avoid long exposure to high temperatures. +25° C is recommended for long-term storage.

## Ordering Information

**DM-3100U1-1:**  $\pm 2$ Vdc Input Range  
(Supplied With Free Connector)

**RN-3100/4100:** Range-Change  
Accessory Kit for DM-Series Meters

## DM-3100U1 COMPONENT LOCATIONS \*

\* Refer to DATEL RN-3100/4100 Range-Change Accessory Kit data sheet for detailed modification instructions and R1 & R2 locations.

R1, R2 ARE USER-INSTALLED ATTENUATION OR SHUNT RESISTOR (R2)

FULL SCALE (GAIN) ADJUST POTENTIOMETER (R8)

OFFSET POT. R16, 50 kΩ USER-INSTALLED ½" RECTILINEAR BOURNS 3006 P-1 SERIES OR EQUIVALENT (DATEL TP-50K.)

Pin B1

Pin B15

KEYWAY

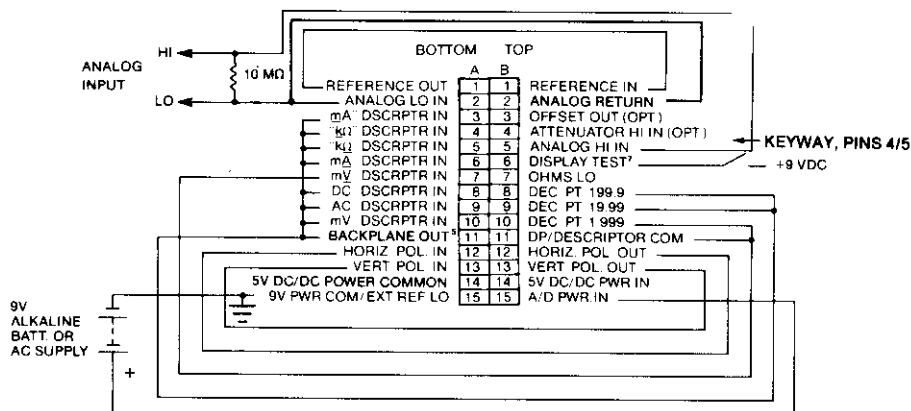
## NOTES:

- (1) R1, R2 ARE USER-INSTALLED ATTENUATION OR (R2) SHUNT RESISTORS. BEFORE INSTALLING RESISTORS AT R1, OPEN SOLDER GAP (SG1) ON COMP. SIDE OF BOARD WITH A SOLDERING IRON. NOTE THAT, IF R1 IS LATER REMOVED, THE USER MUST CLOSE THE SOLDER GAP.
- (2) ALL UNUSED DESCRIPTORS AND DECIMAL POINTS MUST BE CONNECTED TOGETHER TO A11 (BACKPLANE OUT).

## INPUT/OUTPUT CONNECTIONS WITH SINGLE-ENDED INPUT

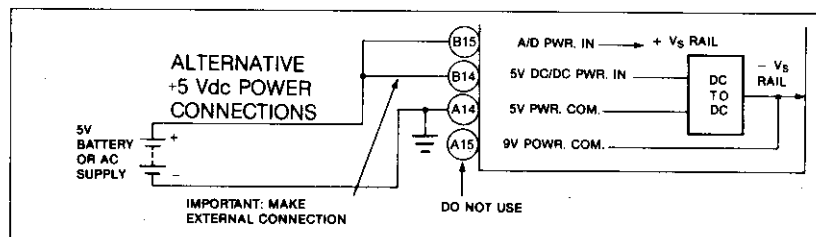
CAUTION: Observe CMV range limits on single - supply applications referred to pin A15. Differential mode or batt. power is preferred. Contact Datel for assistance.

## DM-3100U1

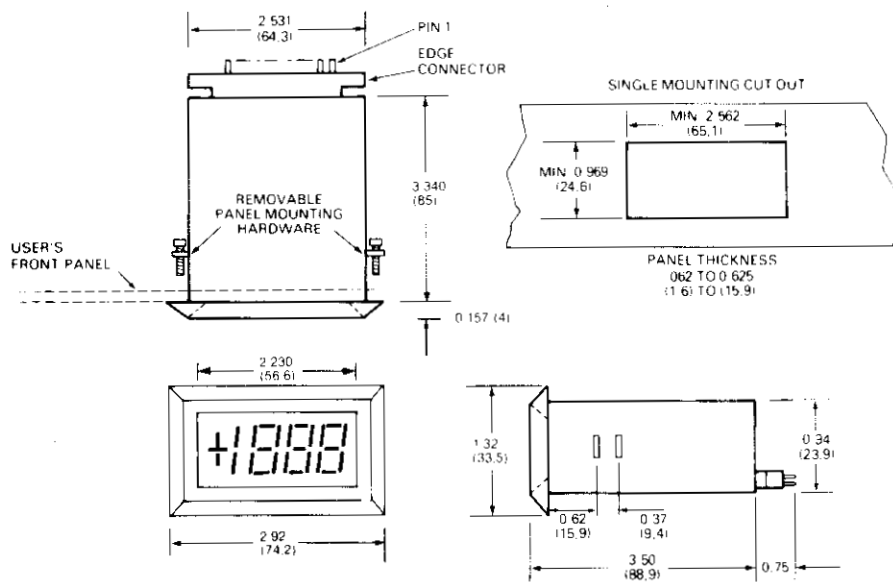


## NOTES:

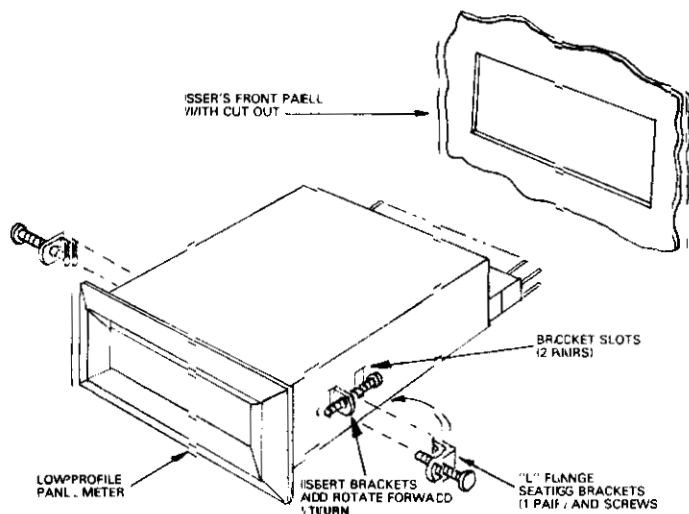
1. This shows the connector rear with the DPM tilted on its side.
2. CAUTION: CMOS inputs. Avoid damage from static discharge. Handle only with ground protection.
3. ANALOG RETURN = +Vs - 2.8 Vdc.
4. Connect all unused Decimal Points, Descriptors and Signs to BACKPLANE OUT (PIN A11).
5. Descriptors A3 through A10 DO NOT select functions. Users must install additional components to measure Ohms, mA, etc.
6. Hold meter in DISPLAY TEST no longer than 1 minute to prevent damage to display.



## MECHANICAL DIMENSIONS INCHES (MM)



## PANEL MOUNTING



The low profile case is retained in a front panel cutout by sliding the DPM housing in through the cutout opening and securing the housing from the rear using 2 "L" brackets and screws. Proceed as follows:

1. After determining the correct position, form a cutout in the mounting panel. Refer to the cutout drawing for proper dimensions.
2. Install the panel meter from the front (display) side of the mounting panel as shown.
3. There are two pairs of slots in the side of the case to receive the L-brackets and retaining screws. Most applications will use the front pair of slots. For panels thicker than about 0.25 inches (6 mm), use the rear slot pair.
4. A thin plastic molding may cover the selected slots. This can be broken through with the L brackets in the next step or can be removed using a screwdriver or knife before panel mounting.
5. Assemble the supplied 4-40 screws into the L brackets as shown, turning the screw until several threads are engaged.
6. **Using the screw as a lever**, push the short side of the bracket into the slot as shown and **rotate the**

**screw backwards** ¼ turn until the screw is parallel to the case side and the L bracket is fully captured in the case.

7. Lightly tighten the screws against the front panel.

## CIRCUIT BOARD ACCESS

If access to the internal circuit board is required, bow the rear cover plate backward by prying up in the center with a small screwdriver or knife blade, to release the two catches in the side of the case. When reinstalling the circuit board, first be sure the front filter is flush against the inside of the housing. The circuit board engages a pair of guide tracks which are molded inside the case. When reinstalling the rear cover plate, be sure the trim pot access hole is to the lower left when facing the rear. Compress the cover plate slightly so that it snaps into the two retaining slot catches at the rear sides.

If a second user-fabricated circuit board is installed in the upper pair of board guide tracks, the upper connector slot (if used) in the rear cover plate may be opened by using a knife from inside the cover.

### DIFFERENTIAL INPUT WITH SAMPLE RATIOMETRIC CONNECTIONS.

The DM-3100U1 has a reference in-out loop which makes possible ratiometric measurements. Representative connections are illustrated below. Ratiometric operation eliminates changes in the DPM reading due to voltage variations in the Bridge's external excitation source. The input gain on the DM-3100U1 varies inversely with voltage at Reference In — as REF IN voltage increases meter gain decreases. Meter input gain thus can be made to compensate for variations in the bridge excitation source voltage. (The DPM is set for unity gain when REF IN V equals +1V as referred to EXT. REF. LO.)

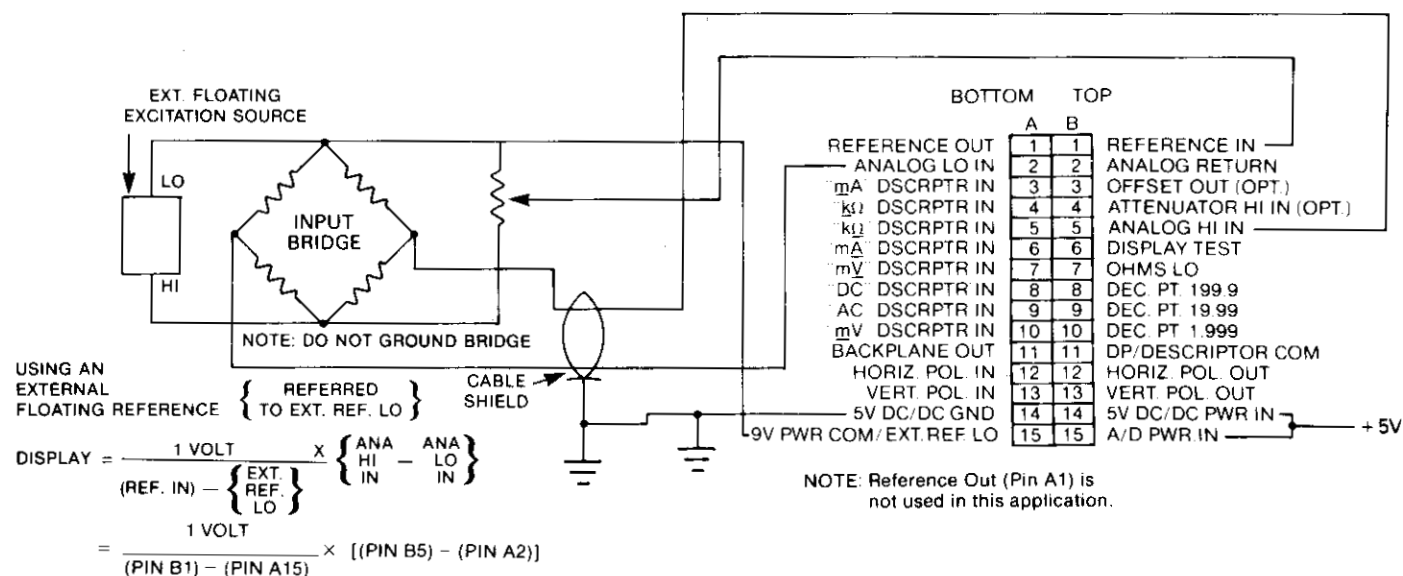
For all applications,  $V_{IN} = 2 V_{REF}$  at full scale (1999 counts). For small values of  $V_{REF}$  (100 mV or lower), increased display noise, nonlinearity, rollover and CMR errors will be apparent. Avoid  $V_{REF}$  inputs beyond about 2V to prevent integrator satu-

ration with full scale inputs. Variable  $V_{REF}$  is not intended for wide gain changes as in multimeter applications. Instead, it should be used for drift correction, scaling to engineering units, or for modest amounts of gain.

A note on grounding: The DM-3100U1's internal voltage reference source is biased against the internal negative supply rail (EXT. REF. LO). Note that this is not the same electrical connection as the 5V Power Common connection. Refer to the Simplified Block Diagram.

Because of this configuration, external reference sources should be isolated from the 5V Power Common and should have the Reference Lo Output from the external source connected to the negative supply rail.

### DM-3100U1



### DIGITAL OHMMETER CONNECTIONS

The digital ohmmeter circuit uses the DM-3100U1's ratiometric capability. An external reference resistor of known resistance, accuracy, and temperature drift is connected in series with the unknown resistance. A constant, stable voltage from the DPM's internal reference diode is applied to the resistor pair to produce a constant current. This current develops two voltage drops across the resistors which are proportional

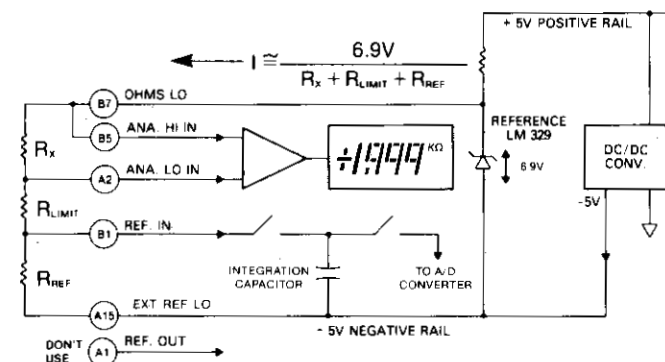
only to the ratio of the resistances since the current through them is identical.

The chart below lists recommended  $R_{REF}$  and  $R_{LIMIT}$  resistance values corresponding to different ohmmeter ranges. Values of  $R_{LIMIT}$  were selected to limit the current through  $R_{REF}$  and  $R_x$  to 1 milliamperes maximum.

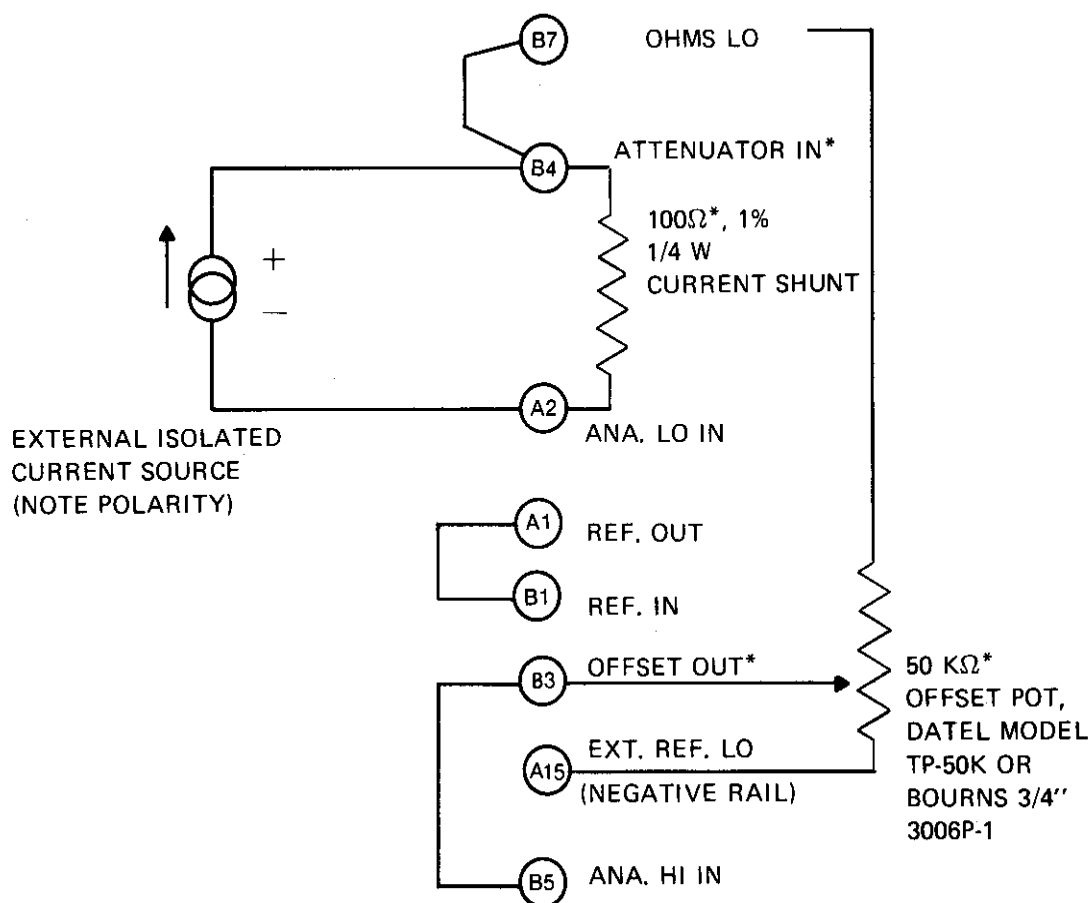
RANGE	RESOLUTION	$R_{LIMIT}$	$R_{REF}$	DECIMAL POINT <sup>2</sup>
19.99 MΩ	10 kΩ	22 MΩ	10 MΩ	B9 to B11
1.999 MΩ	1 kΩ	3.6 MΩ	1 MΩ	B10 to B11
199.9 kΩ	100 Ω	360 kΩ	100 kΩ	B8 to B11
19.99 kΩ	10 Ω	36 kΩ	10 kΩ	B9 to B11
1.999 kΩ	1 Ω	6.2 kΩ	1 kΩ	B10 to B11

- <sup>1</sup>  $R_{LIMIT}$  and  $R_{REF}$  should be metal film, High Stability Resistors (AS RN60C).
- All unused decimal points must be connected together to All (BACKPLANE OUT).

$$\text{DISPLAY} = \frac{E_{IN}}{V_{REF}} \times 1V = \frac{I R_x}{I R_{REF}} \times 1V = \frac{R_x}{R_{REF}} \times 1V$$



## 4 TO 20 MA PROCESS TRANSMITTER INPUT FOR DM-3100 SERIES DIGITAL PANEL METERS



### GENERAL DESCRIPTION

This circuit accepts an isolated dc unipolar current signal from common industrial process transmitters and transducers which generate 4-20 mA dc current outputs. The circuit may also be adapted to grounded (non-isolated) current sources.

### APPLICATION NOTES

This circuit may be used on Datel-Intersil's DM-3100 series Digital Panel Meters. \*On the DM-3100U1, U2, U3 and DM-3100N models, the circuit is wired up exactly as shown. On these models, the 100Ω resistor may be mounted internally across both the R1 and R2 positions (leave R1 open). The 50 KΩ pot is mounted in position R16 on these model DPM's.

On Models DM-3100L, B, and X, these two components cannot be internally mounted on the board. Close the solder gap SG1 and mount the two components externally. Since there is no ATTENUATOR IN connection on the DM-3100L, and X, simply connect the 100Ω resistor and the current source **together at the OHMS LO** connection. Also, there is no OFFSET OUT connection on these models, therefore, the wiper arm of the 50 KΩ pot should be connected directly to the ANA. HI IN connection.

**The current source must be isolated (floating) for this circuit to work. There must not be any ohmic path to ground from the 4-20 mA current source. If this cannot be done, float the whole DPM by using a transformer-isolated +5 Vdc power supply such as Datel-Intersil's UPA-5/500. The DM-3100B is already floating. Note the correct polarity for the current source.**

### CALIBRATION PROCEDURE

1. Apply 4 mA from a calibrated external current source.
2. Adjust the offset pot for the desired low reading (or zero).
3. Apply 20 mA from the current source.
4. Adjust the DPM's full scale gain pot for the desired high value.
5. Both adjustments interact slightly, therefore, repeat steps 1-4 until no further improvement can be obtained.

It is common for industrial 4-20 mA sources to represent 0 to 150 P.S.I. for example, as 4 to 20 mA. Therefore, the DPM can be adjusted to directly display engineering units.

DS-0045 Reprint 03/90

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